be explained, but to be constantly kept before one's attention, this particular infection had a selective action upon the peripheral nervous system and caused the symptom-complex known as peripheral polyneuritis; (5) clinicopathologically the milk, throat cultures, blood, fecal examinations and urinary tests for bacteria showed in general the staphylococcus; (6) pathologically there was observed an acute hemorrhagic gastro-enteritis, multiple focal necroses of infectious origin in the liver and acute hemorrhagic neuritis (hemorrhages between the nerve bundles).

Therefore, clinically and pathologically, the diagnostic grouping of these cases has been placed in the acute infective enteritis group with a polyneuritic syndrome.

FUNCTIONAL BLOOD-PRESSURE.

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In contradistinction to those permanent or organic changes in the circulatory apparatus which signify their presence by a constant or stationary sphygmomanometric reading, hypertensive in character, and about which medical opinion accepts the rising valuations as of supreme clinical importance, there must also be recognized, and properly evaluated, a larger group of variations, primarily functional in nature, and which, while at times hypertensive in reading, are due to disturbances of a functional or physiological character.

This first type is understood as being organic or permanent and the latter as functional or transient.

The first is pathological and therefore a factor for serious concern; the latter is still considered as within the elastic bounds of the physiological and must be so interpreted, and therefore kept from passing over into the domain of the pathological.

The vital and essential principle always to be recognized when considering the importance of blood tension lies in this fact—this great truth—that the etiological factors causing this rise in the blood tension within the bloodvessels, numerous and diverse though they be, act by causing an elevation of the blood tension or pressure primarily, and only secondarily do the more permanent or organized changes follow as a result of the irritation or disturbances being long continued.

In the understanding of functional blood-pressure disturbances, as well as the arteriosclerotic changes in the bloodvessels, the structural elements or anatomy of the bloodvessel wall must be kept in mind.

The walls of the arteries consists of three coats, which, named from their relative position, are the inner, the middle and the outer. The structure and relative thickness of these coats or tunics vary in vessels of large, medium and small caliber.

The media or muscular coat is the thickest coat of the artery and the one upon which attention is focussed. It consists of many circular lamellæ of involuntary muscle fibers, intermingled with connective tissue, in which elastic fibers are conspicuous. This muscle tissue gradually attenuates as the capillaries are approached, until finally, in the capillaries themselves, no muscular fibers appear, only nucleated endothelial cells. Finally, the capillaries, by their union, constitute the capillary plexus, *i. e.*, the retia capillaria.

As regards the innervation, it is well to recall that the sympathetic, through its vasoconstrictor and its vasodilator fibers, maintain vessel tonicity.

Luciani[1] states: "There are, accordingly, constrictor and dilator nerves to the bloodvessels, the former corresponding to the systolic and the latter to the diastolic nerves of the heart. Vascular rhythm and tonicity are analogous to cardiac rhythm and tonicity."

Foster[2] says: "We have repeatedly insisted that the relaxation of a muscular fiber is as much a complex vital process, and as truly the result of the muscular substance, as the contraction itself, and there is *a priori*, no reason why a nervous impulse should not govern the former as it does the latter."

From the vasomotor center, then, is the tonicity of the vessel controlled. Thus, any influence, metabolic, endocrinologic, toxic or psychic, may affect the musculature of the vessels with the production of constriction, and this constriction, through the development of the muscular overaction, may result in the condition of hypertonus.

Through the action of localized contractions in the great splanchnic areas there may be a pressure rise (functional hyperpressure) or a fall through splanchnic relaxation.

Our reasoning thus leads us to the belief that a prolonged influence of the vasomotor controlling mechanism, through the agencies of faulty metabolism, etc., or by the production of overdevelopment of the muscular tissue in the walls of the arteries, with the resultant hypertonus, may also be at the foundation of the functional hypertensive blood-pressure.

Degeneration in the walls of the bloodvessels may develop without the production of a raised blood-pressure, but where it becomes a factor of danger, and of serious concern to the circulatory balance, it always follows this period of functional or physiological rise instead of preceding the same. Therefore, the fundamental feature for correction, and the great clinical value of this question of blood-pressure, are to be found in this early knowledge of the disturbing elements in the blood stream, acting in the twofold relation of causing a primary elevation of pressure and associatedly a structural though an insidious change in the vessels themselves. As mentioned, these arterial changes and sclerotic lesions may develop in the peripheral vessels in the aging and aged even to the formation of calcareous plaques, as noted in the senile or decrescent type of arteriosclerosis described by Clifford Allbutt, without causing a manifest elevation in the arterial pressure. In contradistinction to this fact it may also be noted that a permanent hypertensive reading is frequently observed in persons about the fourth or fifth decade, in whom no outward evidence of arterial sclerosis can be discovered, though positive changes have taken place in the cerebral or splanchnic vessels. This condition has likewise been fully described by Allbutt and called hyperpiesis. Reference will be made to this condition later.

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[1] Human Physiology, vol. i, p. 343.

[2] Text-book of Physiology, Part 1, p. 313, 5th ed., 1888.

Between the great group of diffuse arteriosclerosis, chronic Bright's and hyperpiesis, with permanent organic and fixed hypertension and the great group of normal cases, so called because it is necessary to have an approximate standard even though the normal limit of flexibility may be greater than at present accepted, there lie two groups of functional blood-pressure conditions which may be termed:

1. Functional hypertensive blood-pressure cases.
2. Functional hypotensive blood-pressure cases.

A consideration of these two groups may be of value.

1. FUNCTIONAL HYPERTENSIVE BLOOD-PRESSURE. Our increasing knowledge of the dynamics of the circulation discloses the fact that pressure or tension, high or low, in the vessels are registered by the mercury manometer, and as recognized clinically, is a condition of functional variation which may affect the individual at all ages and under various circumstances of life. For instance, changes or variations may be brought about at different hours of the day; it may be influenced by the mental attitude or the type of diet and by emotion, especially anger, particularly when suppressed through ideas of dignity. This may so elevate the tension as to cause bronchial wheezing, and an asthmatic cough, especially where the tonicity of the cardiac musculature is subnormal. Strenuous exercise will raise while rest will lower the arterial tension.

Normal blood-pressure, it may be mentioned, is dependent upon a properly functionating vasomotor system; upon the integrity, strength and energy of the cardiac musculature; upon the normal elasticity of the arterial walls; upon the volume of the circulatory blood—its viscosity—and upon the peripheral resistance. Thus, anything that disturbs the physiological harmony of this mechanism will naturally influence or alter the mechanical agencies of its flow and so register a change in the blood-pressure or tension. Attention has rightfully been called to the fact, by many authors, that this recorded pressure or tension is classed as a symptom and not as a disease. As a symptom it proves of inestimable value in the study of disease. It thus aids in the differential between the organic and the functional lesions.

Realizing, then, these functional variations in the manometric reading it is advisable to repeat the observations a number of times, and on different occasions, when making a study of hypertension. Take the pressure after eating, after exercise, and after a prolonged rest. It may be advisable for the observed patient to remain recumbent for a period of twenty-four hours, with strict attention to the diet, and with full intestinal elimination, before the final judgment is rendered.

If the case is functional, a marked reduction in hypertension is witnessed; if organic, no marked change results.

Etiology. It may well be asked and answered: What are the usual causes for heightened pressure? Usually due to errors of diet, eating and, previous to the advent of prohibition, drinking, long continued; combined with a life of worry, mental depression and emotion. In the largest number of cases, disturbances in metabolism, by which is inferred those forms of destructive metabolism whereby faulty end-products of digestion, toxic to the living somatic cells and vasomotor center, maintain a constant pressor effect, through irritation, with the eventual development of the productive changes in the cells themselves. Many persons observe little judgment in their gastronomic seances, with the resultant overwhelming of the system by the toxic products developed. Intestinal stasis, from whatever cause, with biliary deficiency, hasten the production and the absorption of these putrefactive toxic products.

Auto-intoxication. This resultant of the abnormal or destructive metabolism undoubtedly lies at the foundation of the hypertensive and arteriosclerotic alterations. Intense is the discussion surrounding this subject, and intensive are the efforts of the chemicophysical laboratories to fathom it.

Dr. Louis Faugeres Bishop,[3] in seeking to solve the "riddle of arteriosclerosis," develops a convincing case against auto-intoxication. To quote: "I believe (the key) is to be found in the still obscure field of biochemistry, and I believe in the end it will be discovered that the reason for the perfectly apparent increase of arteriosclerosis of modern time is to be found in the well-known changes with regard to the habit of people in connection with protein food and the different manner in which they are handled commercially, together with some factor or factors, yet to be analyzed, that render food idiosyncrasies of a low grade producing unconscious poisoning."

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[3] Arteriosclerosis, 1915, p. 15.

Professor Victor C. Vaughan[4] discusses this problem from the standpoint of individual protein sensitization and anaphylaxis. He states from laboratory experience, "The protein poison is a powerful agent," acting against the vital somatic cells.

Luciani[5] quotes, as the result of the action of intestinal bacteria in their transforming action on the carbohydrates, fats and proteins, the following:

"On carbohydrates: By fermentation, the production of alcohol, lactic, benzoic, succinic, butyric and valerianic acids; also carbonic acid gas, methane or marsh gas and hydrogen gas.

"On fats: The production of glycerol and fatty acids.

"On proteins: The toxic putrefactive elements: proteoses, peptones and amino-acids. These amino-acids are very complex and subtle agents for good or for evil."

According to Lusk:[6] "One must know the life of sixteen amino-acids in order to be familiar with the metabolism of protein." These nitrogenous bodies, indol, scatol, phenol, pancresol, phenyl-propionic acid, etc., are toxic agents of very great moment. In addition, a group of chemical compounds, the so-called ptomains, appear; these little-known alkaloids are powerful agents of destruction."

With such in mind it is evident that if these products of putrefactive activity and metabolic decomposition acted suddenly they would very quickly overwhelm the vital resisting forces of the human organism. Therefore, when acting, in cases of intestinal stasis, very gradually and over long periods—decades—they produce the changes in arterial compensation and degeneration, with the production of this primary functional, and eventually a permanent or organic blood-pressure variation.

This is what is intended by the term destructive metabolism.

Other Causes: Endocrine disturbances, especially of the thyroid, with the association of hyperthyroidism, when long active, gradually produces an overacting heart; with the development of hypertrophic changes in both the cardiac musculature and the musculature of the walls of the arteries.

Blood-pressure observations, by calling attention to this state, may spare the organism from the terminal apoplexy or cardiac exhaustion.

Infectious Agents: The ubiquitous microbe, the bacterial organism and their toxic products undoubtedly act to the detriment of the somatic cells. Undiscovered areas of focal infection must be credited as etiological agents.

Syphilis and the metallic poison, etc., add to the list.

The hypertension of nephritis is assumed to be organic. Little attention, therefore, is given to it under the heading of functional hypertension; still:

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[4] Am. Jour. Med. Sc., February, 1913.

[5] Human Physiology, vol. iii.

[6] The Science of Nutrition, 3d ed., p. 175.

The etiology of this large class is unsettled, for while there are many theories the only one thoroughly confirmed is that of Janeway, Carrel, Sampson and Pearce, who proved that the reduction of the amount of kidney substance alone may cause hypertension.

Attention is directed to the fact that the early changes may to a degree be assumed to be functional. Thus the early use of the manometer would prove a safeguard against neglect or oversight and the ultimate evils attendant upon a true nephritis.

Hyperpiesis: Vitally important is it, in cases showing signs of high pressure, to early assign the condition to its rightful category. A class of cases very frequently met with during these days of strenuousness is the one so fully described by Clifford Allbutt, regius professor of physic in the University of Cambridge, England, and called by him hyperpiesis. It seems to be little understood by the profession at large. Allbutt defined this condition as a state or disease whose essential feature and earliest manifestation is hyperpiesis or elevated blood-pressure. Its causes probably fall within the category of etiological factors given. At first the response to the irritations causing the heightened pressure is wholly functional, but in the course of time, the causative factors still acting, it is followed by the cardiac hypertrophy and by the arterial sclerosis. It then is classed in the list of the organic high-pressure cases. My reason for introducing it here is to call attention to the undoubted fact *that early in its history it comes under the functional high-pressure classification, and so merits attention.*

Houchard calls this early period "the presclerotic state."

Clifford Allbutt states emphatically:[7] "If we catch hyperpiesis early, and keep at work against it, it can be cured more often than not." Occurring in people of apparent robust health, it progresses insidiously months and years before it is suspected. Only by the regular use of the sphygmomanometer can it be detected early. When the first symptoms of dyspnea, from the breaking down of the heart's reserve force, appear, or the presence of precordial or substernal oppression or pain is experienced, or a sudden attack of pulmonary edema upon exertion or symptoms referable to the cerebral vessels, *i. e.*, slight shock or warnings from vasomotor spasms, result, the process is well advanced.

A period of increasing nervousness, irritability or consciousness of the burden entailed in holding one's position in life, and a similar consciousness of a lessened ability to meet the same with undue fatigue, these register clinically the earliest signs and bespeak for recognition and a successful therapy. Thus: suspect the tendency to, or the presence of, hyperpiesis in every full-blooded, stocky man or woman of plethoric habits, active temperament and with hearty appetites at the period of the late middle life, between the ages of forty-five and fifty-five years.

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[7] Diseases of the Arteries, Including Angina Pectoris, vol. ii, p. 81.

Climacteric Hypertension. So deeply impressed is the profession with the thought that hypertension is synonymous with nephritis, and that even hyperpiesis must always be, to a degree, allied to chronic Bright's, that there hardly seems room in their thoughts for this essential truth about pressure: that functional hypertension can occur in many and diverse conditions.

I wish also to suggest that there is a type of high pressure frequently found in women at the period of the menopause. These cases do not show any evidence of arteriosclerosis and no obtainable evidence of nephritis, either in the blood or in the urine. The retinal picture is likewise normal. To this class, then, the term hyperpiesis hardly seems correct, because they develop during or subsequent to and are apparently closely associated with that complex function of ovulation and ovarian glandular secretion, with their influence over all bodily functions.

During this period of ovarian dysfunction, and especially following its cessation, these patients develop a group of unassociated symptoms, nervous, gastric and cardiac in origin, which cause them to seek relief. As a rule, they are healthy in appearance, rather obese, though not necessarily so; are active, nervous and inclined to worry. They are met with between the years of forty and fifty years. They have headache, vertigo, paresthesias, epistaxis, numbness or sleeping of the extremities. On examination they show a high arterial blood-pressure, usually about systolic 200 and diastolic 120 mm. Hg.

Under rest, diet, bromide sedation and endocrine medication a very pronounced drop in the pressure is obtained, to their very great relief.

Arthur H. Hopkins[8] has described a group of these cases. The condition might be more fully elaborated. Attention is directed to it for the purpose of classifying it among the functional pressures and to suggest that a routine blood-pressure examination be made in all women at the menopause seeking relief from the obscure symptoms enumerated above.

Do not call these cases hyperpiesis, rather climacteric high-pressure cases.

Functional High Pressure in Obstetrics. To the obstetrician the knowledge of functional blood-pressure is of the highest importance. The response of the arterial controlling mechanism to the toxins developed during pregnancy causes a hypertonic rise, which at once suggests the advent of a toxemia and foreshadows the advent of the dreaded eclampsia.

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[8] Am. Jour. Med. Sc., June, 1919, p. 826.

It is well to recall that the normal blood-pressure in a normal healthy pregnant woman will average close to 118 mm. Hg, with a gradual increase in the later months.

During the early months of the pregnancy, with nausea and vomiting, the toxemia or endocrine imbalance may cause the pressure to fall a few points, especially in severe cases. My experience seems to warrant the belief that feeding these patients with ovarian glandular substance restores this fall.

But, and here is the factor of real importance: To every physician who cares for maternity cases it should be known that a high 150 to 160 mm. Hg reading and a rising pressure in the latter half of pregnancy, and especially so when associated with albuminuria, constitute, very often, the earliest signs of a toxemia, which may suddenly terminate in eclampsia.

This hypertensive blood-pressure is purely functional, for following the birth of the child, in eclampsia, usually within forty-eight to seventy-six hours the pressure will fall to figures approximating normal. Therefore, as far as it is possible to outline suggestions in maternity cases, the following is suggested:

Invariably, upon the acceptance of a maternity case, obtain the blood-pressure data and record the same. Throughout the early periods verify the findings monthly. In the latter half of the pregnancy a blood-pressure below 124 mm. Hg may be disregarded. A pressure reading, however, from 125 mm. to 150 mm. Hg needs very careful watching. A pressure over 150 mm. Hg, when the original normal pressure was about 120, is considered fraught with danger and needs very careful eliminative measures; and should it show a tendency to rise higher the induction of premature labor should be considered.

The role, therefore, of the sphygmomanometer in pregnancy is a very important one. As a corollary to the above, after delivery, in involved cases, the persistence of the high pressure must always be considered of moment and the case watched and treated until it falls to normal.

The modern scientific care of maternity cases, therefore, includes the routine use of the manometer, with a view to the recognition of the functional elevations proved of such supreme importance.

Hypertension in Cerebral Hemorrhage. In apoplexy the cerebral hemorrhage always causes a marked functional use to heights greater than the previously registered heights maintained by the organic causative factor. A recent case with original systolic pressure of 225 mm. Hg, diastolic 115 mm. Hg, prior to the hemorrhage, rose within one-half hour to the high figure of 285 mm. Hg systolic and 150 mm. Hg diastolic The resulting coma continued until the pressure gradually fell to 230 mm. Hg systolic and to 130 mm. Hg diastolic, when consciousness returned.

Hypertension in Typhoid Fever. In the course of typhoid fever the pressure is liable to decline below the normal readings for the patient in health. A sharp rise in the blood-pressure accompanied by abdominal pain suggests perforation of the intestinal wall.

Hypertension in Cerebral Growth. A rising pressure is usually associated functionally with the headache, vomiting and papilledema of cerebral growths. Removal of the growth lowers the pressure.

2. THE FUNCTIONAL HYPOTENSIVE BLOOD-PRESSURE CASES. A very important group of cases showing hypotensive or depressive readings are frequent claimants for medical consideration. This condition, while not as spectacular as the hypertensive group, is no less important, and merits intensive study for its proper differentiation and treatment.

The condition is often associated in the minds of the physicians, and even of the patients themselves, with the idea of cardiac exhaustion; but while the inherent cardiac musculature may not be fully normal and is usually subnormal, still the lowered tone so evident is more likely due to deficiency of the vasomotor function from whatever constitutional cause. Constitutionality, then, is very evident in these subjects.

It is essential to remember, however, that a low arterial pressure may be practically normal for a particular individual, and it by no means follows that the arterial pressure is abnormal, because it is below the average level of pressure generally present in a healthy subject of the same age.

Cases are seen in early and middle life enjoying health and doing their work, in whom the arterial pressure has not exceeded 90 mm. Hg systolic and 60 mm. Hg diastolic. A very recent pregnant woman of twenty-four years showed a systolic reading of 85 mm. Hg and a diastolic reading of 50 mm. Hg. No complaint except indisposition to exertion was made. While this latter borders on the abnormal and prompted measures for its improvement, it is cited as evidence of the elasticity of the normal limits of pressure.

A hypotensive pressure must be considered functionally pathological, however, when conjoined with signs and symptoms of impaired health and sense of well-being.

Hypotensive cases may be separated into several groups:

1. The Tuberculous Group. Constitutional deficiency, through direct tuberculous inheritance, is a profound factor in depressive conditions.

Tuberculosis affects the vitality of the whole organism, hence the low readings. It is well, therefore, to always suspect a tuberculosis, active or latent, in those cases of young men and young women between the ages of sixteen and twenty-six years who, while showing wasting and anemia, have an associated hypotension.

2. Endocrine Deficiency:
    A. Toxemic group.
    B. Pituitary group.

A. *The Toxemic Group.* Recent studies of the dominance of the endocrine glands over the physical functions and the vasomotor balance have awakened intense interest in this specific group. This class of patients show no evidence of tuberculosis, look normal to casual observation, but suffer with a depression of their vital functions termed asthenia. They lack "pep," are easily tired and have no reserve. By force of will they may rise to the occasion for the time, but readily revert to the expressed state of fatigue. They are especially met with among young women who are relegated to the class of neurasthenics for the want of a better comprehension of their ailment. At the present time it is realized that asthenia or neuromuscular depression, with its hypotension, is really a condition of cellular intoxication. According to Henry Harrower, "If the regulating mechanism that controls the circulation, cardiac efficiency and blood-pressure is insufficient, then asthenia must result from the accumulation of the ordinary amounts of cellular waste." The chief cause of this group, with its asthenia, appears to be due to a condition of chronic toxemia from faulty oxidation and deficient elimination.

By the use of the products of glandular substances from the adrenal body, with its synergist the thyroid, augmented by lecithin elements a marked restoration of the proper functioning of these bodily organs lessens the asthenia and raises the pressure by the activating effect upon the vital functions themselves.

So marked is the benefit derived by this class of hypotensive cases that efforts should be made to recognize this type among the depressive groups. Whether or not adrenalin acts, *per se*, to raise blood-pressure the present opinion seems opposed to the theory. Experience, however, does show that the use of the suprarenal glandular substance, aided by other therapeutic measures, does so act on the psychonervous functions as to sustain them and eventually cause a restoration to more normal conditions.

B. *The Pituitary Group.* Again: Must deficiency of the endocrine elements be recognized as a provocation of not only low blood-pressure but also of a low constitutional state itself?

Dr. Walter Timme[9] describes a series of cases observed at the Neurological Institute of New York City, undoubtedly due to pituitary deficiency. These cases are constantly seen in practice, are not recognized, and are wrongly diagnosed and wrongly treated. They all suffer from some psychosis associated with their bodily deficiency. Timme refers to the condition as "A new pleuriglandular compensating syndrome."

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[9] Medical Clinics of North America, January, 1919.

They show symptoms of intratemporal headache, great fatigability, low blood-pressure (hypotension), skeletal growth abnormalities and usually sex deficiences.

They are seen in both early, middle and late stages, or from adolescence to middle life.

This syndrome seems to involve the thymus, adrenal, thyroid, gonads and pituitary bodies.

Beginning in early life through a failure of the thymus function a necessary compensatory development of the other glandular bodies is imperative for the continuance of the organism. Seen first in youth some years before or after puberty it continues actively for a period of about twenty years.

The first symptoms are those of the thymicolymphatic state observed between the years of ten and fifteen. The second or compensatory pituitary state of puberty between ten and twenty; the pituitary gigantism state between twenty and thirty; and finally the developed state of acromegaly.

Low pressure is incident to all stages.

The functional character of this complex condition is evidenced by the marked general improvement following the feeding of these patients with pituitary gland products, a corresponding rise in the blood-pressure indicating the functional hypotensive nature of the vasomotor condition.

3. *Infectious.* Bacterial invasion of the body functionally depresses the vital activities, both by their presence and by the developed toxins. Influenza, pneumonia, diphtheria, typhoid, etc., are all associated with depressive readings. So profound may be the depression as to quickly overwhelm the organism.

Convalescence should be guided by the manometer in order to direct the activities of the patient.

4. Shock, hemorrhage, vomiting and diarrhea account for many low readings, the correction of the cause restoring the pressure.

5. With a view to the above outlined conditions it is evident that the functional aspect of the question of blood-pressure is a very important one, to be given consideration in every case of hypertension and hypotension before assigning the causative condition to that of the organic or permanent type; and that it is during the period of this functional development that therapeusis and associated methods of treatment warrant the expectation of success. Efficient treatment is dependent upon accurate diagnosis: To differentiate therefore, between the functional and the organic disturbances is the *sine qua non* of success.